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Ayal Kimhi, Ofir Rubin

June 2007

Working Paper # 07012

Department of Economics Working Papers Series

Ames, Iowa 50011

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Ayal Kimhi
Department of Agricultural Economics and Management
Faculty of Agriculture, Hebrew University
P.O. Box 12, Rehovot 76100, ISRAEL
Phone 972-8-9489376
Fax 972-8-9466267
E-mail: kimhi@agri.huji.ac.il

and

Ofir D. Rubin
Department of Economics, Iowa State University
75 Heady Hall, Ames, IA 50011, USA
Phone 515-294-5452
Fax 515-294-0221
E-mail: rubino@iastate.edu

Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Portland, OR, July 29-August 1, 2007

Assessing the Response of Farm Households to Dairy Policy Reform in Israel

by

Ayal Kimhi and Ofir D. Rubin*

December 2006

Abstract

After nearly fifty years of stability and stagnation of dairy market regulations in Israel, a dramatic policy reform has been enacted in 1999. The reform enabled farm households, for the first time, to trade production quotas. In addition, the reform signaled to farmers that milk prices will gradually go down in real terms, and therefore only producers who expand and become more efficient will prevail. The reform allowed for generous financial support for investment in expansion, but also required the adoption of environmental regulations which could be costly to many farm families. This paper uses data from a census of small family-operated dairy enterprises that was conducted in 2001, in order to analyze the response of farm households to the reform. The results imply that the reform was particularly attractive for already strong producers. Weaker producers are less attracted by the reform and will likely fade away by default in the long run. Another finding is that intergenerational succession is an important element of decision making of milk producers. Hence, the response of farm households to changes in the economic environment cannot be disentangled from the occupational decisions of their offspring. These findings imply that the desired structural change in the family-farm milk production sector will take much longer than expected, essentially as long as the current generation of producers is around. This requires, perhaps, an extension of the reform period or a change in incentives in favor of the smaller and older producers.

Key words: milk policy reform; technology adoption; intergenerational succession.

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* The authors are Associate Professor of Agricultural Economics at the Hebrew University of Jerusalem and graduate student of Economics at Iowa State University, respectively. This research was supported in part by Research Grant Award No. IS-3291-02 from BARD - the United States – Israel Binational Agricultural Research and Development Fund, by Grant No. 118-0019-03 from the Chief scientist of the Ministry of Agriculture and Rural Development, and by a Grant from the Israeli Cattle Branch Administration. We thank Liron Tamir from the Israeli Dairy Board for his assistance with data issues.

Introduction

Dairy farming has been one of the most stable and profitable farm activities in Israel over the years. It accounted for 13% of total farm output in the year 2000. The dairy branch is regulated using production quotas and protected from imports. Central planning is justified by specific attributes of milk as a fresh product and of the production process, and also by the role of the agricultural sector as a whole in achieving national goals such as populating remote areas. In recent years, milk producers are facing two economic threats: opening markets for cheap milk products due to international trade agreements, and enforcement of environmental regulations. In order to prepare for these threats, a market reform program has been launched at the end of 1998. The purpose of the reform was to provide incentives for producers to increase their cost efficiency, especially through increasing the volume of production. A secondary purpose is to help producers meet environmental standards.

The specific ingredients of the reform are: (a) allowing for the trade of production quotas between existing producers, thereby encouraging inefficient producers to quit and efficient producers to expand, and the creation of partnerships among existing producers; (b) subsidizing investments in farm infrastructure that are necessary to increase production capacity and meet environmental regulations; and (c) gradual reduction in the price of milk at the farm gate. It was expected that the price reduction will force milk producers to either quit or expand and become more cost efficient.

Milk production in Israel is divided between collective farms (*Kibbutz*), which include less than 20% of dairy farms but produce more than 50% of milk, and family farms. Dairy farms in the collective farm sector are large, modern, and relatively efficient, while the family farm sector includes a variety of milk producers, the minority of which are large and modern (especially partnerships of several producers), but most of them are small and less efficient. Since the launch of the dairy market reform in 1998 and until the year 2001, 18% of dairy farms in the collective farm sector started to form joint ventures. Few producers in the family farm sector have started joint ventures, but more of them took at least first steps towards increasing production, while other producers quit. Farm size seems to be a major determinant of dairy producers' response to the reform: while the larger producers tend to expand production, the small producers, the elderly, and those without a successor are more likely to quit. A dairy farm census conducted in early 2001 found that about two thirds of active producers definitely want to stay in the business in the post-reform era, and the majority of those are relatively large producers. Less than half of the active producers have taken any step towards this goal, though. As opposed to the collective farm sector, many family farms are still undecided. The question is whether the reform is indeed suitable to the needs and constraints of small producers, and whether it is possible to gain knowledge about those needs and constraints using data on the progress of the implementation of the reform.

The purpose of this paper is to analyze the decisions of family-farm milk producers to join the reform and to take adequate actions. In particular, we will analyze the intentions and actions of farmers with respect to the reform: whether they are committed to continue production and have taken some action towards that, or have decided to quit or are still weighing their response. The results could be used to predict the future path of the reform in terms of producers' participation, and to assess the eventual structure of the sector at the end of the adjustment process.

In the next section we provide some background on dairy market policies and review the relevant literature. After that we describe the data set used in this research. Then we describe the empirical methodology and present the results. The last section offers several policy implications and concluding comments.

Background and literature review

The necessity for a policy reform in the dairy farm in Israel was not due to local economic circumstances, but to global trends and forces which signaled a future impact on world wide dairy markets. For the first time Agreement On Agriculture (AOA) was reached as part of the Uruguay round of World Trade Organization (WTO) in 1994. Aspiring to liberalize world trade and contribute to economic growth and development, the participants signed an accord which consisted of three elements; reducing domestic support to agriculture, increasing market access to foreign supply and reducing export subsidies.

With neither immediate nor extreme impact of the AOA on agricultural markets, Jesse (2003) argues that the contribution of that agreement is by establishing guidelines, rules and protocols for further negotiations for liberalized agricultural trade. Although the AOA did not yield direct or significant change in international agricultural trade, we claim here that the AOA and the decision of setting the talks to be resumed in the year 2000 were signals for countries with high cost of production, large scale of border protection and trade barriers to initiate policies towards the "cloudy days" of liberal trade.

While the reform in Israel is one example to support our claim, Schluep Campo and Beghin (2006) present a comprehensive study of the dairy market in Japan, one that may reinforce our claim as well. The Japanese producers face challenges similar to these of the Israeli family farm dairy producers: aging and shrinking number of farmers which are threatened by environmental regulations. The Japanese dairy market is protected by high tariffs and transportation costs which isolate it from the efficient producers in its region (e.g New Zealand and Australia). Before the AOA and until 1996, production was governed by quotas which could not have been traded. A reform that was launched in 1996 reversed that policy and effectively generated a market for quotas. In addition, a price support program granted deficiency payments and subsidies for determined production quotas. This program resulted in a fluid milk price decline. The reduction in price and the fact that Japan fulfilled its modest commitment of the AOA did not promote a significant change of trade patterns in the region (Peng and Cox 2006; Beghin 2006).

Another Asian country that was isolated from dairy world market until signing the AOA is Korea. The policy of strict direct control of milk imports was replaced by high tariffs and tight tariff rate quotas. The government, via an industry "Dairy Committee," sets the price of raw milk to be higher than the average production cost to support domestic farmers. Although cost has been declining due to technological improvements over the years, the price of milk at the farm gate remained fixed. This has recently led to some policy adjustments in order to allow consumers to enjoy the reduced production costs, and more policy changes are expected in the near future (Song and Sumner 1999; Lee et al. 2006).

The Doha round of the WTO negotiations began in November 2001 and has not been concluded by its recent meeting in July 2006. Talks have been suppressed constantly over a disagreement between the European Union and the United States and many of the developing countries (G20 group). Though not motivated by the same interests, the development countries complained about lack of market access in high income countries and farm subsidies (Fabiosa et al. 2005).

Since 2001, the ongoing negotiations stimulated researchers to study and explore the variety of scenarios and their outcomes on international dairy markets. To give a few recent examples, Dobson (2005) discusses the implications of the Doha negotiations for the U.S dairy industry, Fabiosa et al. (2005) investigate the impacts of multilateral removal of all border taxes and farm programs and their distortions on developing economies, Fuller et al. (2006) study the potential of export growth of dairy farms in Argentina and Chile, Lee et al. (2006) consider the impact of reduced import barriers in Korea, while Peng and Cox (2006) explore the scenario of further trade liberalization of Asian dairy markets. All of the above and many more economic studies of future policy and trade have been based on readily available aggregate data.

The outcome of a policy reform in Connecticut is analyzed by Foltz (2003) using micro level farm data. A price support program was tested as a way of keeping dairy farms in business. In this economic environment farms are profitable and the regulator is not driven by future liberalized trade, but rather by high opportunity cost of land and labor. The findings are that (1) unemployment (lending) rate has a positive (negative) impact on staying in business, and that (2) farm size does not affect the exit decision directly but productivity per cow does. Foltz (2003) concludes by claiming that "price policy alone will not maintain dairy farming in an increasingly suburban state such as Connecticut".

The dairy reform in Israel is not a price support policy; on the contrary, farm investments are subsidized initially and the price of raw milk declines from that point forward in order to prepare for accommodating freer trade with competitive markets. This kind of reform has not been analyzed previously in the economic literature. However, it can be thought of as a special case of technology adoption. The literature on technology adoption deals with new crop varieties (Lin 1991), improved cultivation techniques (Lee and Stewart 1983; Harper et al. 1990; Caswell 1991; Khanna 2001) , and water pollution prevention technologies (Cooper and Keim 1996). Often these are technologies that could be adopted parallel to existing technologies, and in such a case the question is not only whether to adopt but also how much to adopt (Just and Zilberman 1983; Lin 1991). Several authors dealt with adopting a bundle of technologies. Some of them analyze the decision to adopt one technology out of the bundle or the bundle as a whole (Feder 1982; Wozniak 1984; Dorfman 1996), while other describe a gradual adoption of technology components that are not independent of each other (Byerlee and Hesse de Polanco 1986; Leathers and Smale 1991; Khanna 2001).

The dairy market reform in Israel can be described as a new technology that becomes available but requires substantial investments and leads to uncertain profits.

In addition, the reform has several components that are conditional upon each other: it is impossible to invest in increased production capacity without investing in environmental preservation, but it is possible to invest in environmental preservation without increasing capacity. In this sense, the model of Isik and Khanna (2002) is appropriate. Adopting the reform can also be thought of as a diffusion process (Griliches 1957; Knudston 1991; Fernandez-Cornejo, Alexander and Goodhue 2002). Kislev and Shchori-Bachrach (1973) show that the diffusion process can be reversed after it reaches a peak, because changes in market conditions may cause early adopters to quit. Few articles have been written on technology adoption in dairy farms, especially on adopting a growth hormone. Saha, Love and Schwart (1994) look at the decision on how many cows to treat with the hormone conditional on the decision to use the hormone in general, while Barham, Jackson-Smith and Moon (2000) deal with the binary decision to use the hormone that is made jointly with the decision to continue in milk production, which seems to be relevant to our case.

Data and descriptive statistics

The main source of data for this research is a census of family-farm milk producers that was conducted between December 2000 and April 2001, on behalf of the Israeli Dairy Board. 95% of producers were included, for a total of 1,251 farms. The data included several types of information: (a) producer's profile, including age, education, secondary employment, existing of a successor, household size; (b) dairy farm characteristics, including location, production quota, number of cows, calves, etc., partnership status, physical condition, years since last investment, number of milking per day, hired labor, profitability; (c) village attributes, including the existence of cooperation among producers, the existence of a central sewer system, and the existence of a cow feed enterprise; and (d) attitudes towards the reform, including whether the farmer plans to remain in business, investments made towards this aim, reasons for not deciding, reasons for deciding to quit.

Additional data was provided by the Israeli Dairy Board for the years 1996-2001, including details on production quotas, new partnership formation, and buying and selling of production quotas. We also obtained, from the Dairy Herd Book prepared by the Israeli Cattle Breeders association, data on milk quality at the farm level.

The data show that roughly two thirds of milk producers in the family-farm sector plan to remain in business in the post-reform era. Only 7% of the producers plan to quit. The remaining producers are undecided. 87% of producers who plan to stay in business already made some investments. More than half of those who made investments invested both in production capacity and towards environmental preservation. It should be noted that one of the requirements of the reform is that each producer will reach a level of production of at least 600,000 liters. As can be seen in figure 1, before the reform was launched only about 10% of producers in the family-farm sector satisfied this requirement. Hence, it is clear that the other producers will have to make a choice sooner or later, otherwise they will simply fade away by default.

The description of the explanatory variables will be facilitated by looking at their descriptive statistics in table 1. Missing values in various variables limit the sample size to 891 observations. Missing values in the milk components and quality variables limit the sample size further to 616 observations. This is because these data came from a different source, as explained above. In table 1, we present the descriptive statistics of the full sample and the limited sample. The variables of age, professional training and additional employment refer to the farm operator. A farm with a potential successor means that a successor exists but has not made a final decision to become a successor (which is a formality in Israeli cooperative villages (*Moshav*). Production is measured in units of 100,000 liters. Production data was missing for 17% of the farms; hence we set their production level to zero and included a dummy indicator for these farms. 11% of producers are not producing on their own but rather rent out their quotas. Hence we included the dummy indicator of self-producing. The percentages of milk components (protein and fat) are distributed over a rather narrow range. The range of Somatic Cell Count (SCC) is relatively more dispersed. Lower values of SCC indicate higher milk quality and are also correlated with higher milk production per cow. Both milk components and SCC affect the price of milk obtained by the producer. The average milk producer has made his last capital investment more than five years prior to the survey. 53% of producers reside in villages in which the cooperative society is still functioning. 20% of producers take part in some sort of producer cooperation. 41% of producers have access to a feed enterprise in the immediate locality, and 79% of them have access to a central sewer system. 65% of producers have already made up their mind to adopt the reform. The remaining 35% are mostly undecided.

Empirical analysis

In order to analyze the binary decision to adopt the reform, we use the Probit maximum likelihood procedure. This procedure assumes that there exists a continuous latent variable of the *tendency* to adopt the reform, and that the observed binary variable of adoption indicates that the tendency to adopt crossed some unknown threshold. This latent variable is specified as a linear function of explanatory variables. The procedure provides estimates of the coefficients of that function. Using the estimated coefficients, it is possible to compute marginal effects of each explanatory variable on the probability to adopt the reform. In the case of continuous explanatory variables, the marginal effect relates to a change of one unit in the variable. For the binary explanatory variables, the marginal effect is the difference in probabilities between setting the explanatory variable to one and setting it to zero, given that all other explanatory variables are set at their sample means.

We estimate the model using the full sample and the limited sample, including the milk quality indicators, alternatively. This allows us to assess the importance of milk quality and also to verify that other effects, that are consistent across the two versions, are not subject to serious sample selectivity bias. The results of the full sample and the limited sample are in table 2 and 3, respectively. Beginning with the full sample results in table 2, we find that age has a statistically significant negative effect on the adoption probability. The existence of a successor is another quantitatively important explanatory variable. These two results jointly indicate that the most important determinant of the adoption decision is the planning horizon. A simple computation shows that a 45-year old farmer with a succeeding child is 40% more likely to adopt the reform than a 60-year old farmer without a succeeding child. Another important result is that larger producers are more likely to adopt the reform. This could be because they are more profitable or because they simply need smaller investments in order to satisfy the minimum threshold production required by the reform. However, the significant effect of size vanished after adding milk quality indicators as explanatory variables (table 3). To the extent that higher milk quality is associated with higher profitability and efficiency, we conclude that required investments were not the cause for the size effect on the adoption decision.

We also find that milk producers that are already taking part in a partnership are more likely to adopt the reform. This makes much sense because the combined production of the partnership is probably larger than that of a single producer and hence the required investment in production capacity is smaller. Years since last investment decrease the probability of adopting the reform. This could be due to two reasons. First, the required investments may be higher for farms who have not invested for a longer period. Second, lack of recent investment may indicate a long-run tendency not to continue in milk production, for various reasons that are not captured by the other explanatory variables. Being a part of a producers' cooperation also increases the probability of adopting the reform. This result is reasonable, provided that such cooperation is likely to enhance efficiency of production. Finally, farms in the southern part of the country are least likely to adopt the reform. This result is disturbing, since from the point of view of environmental regulations, southern farmers have an advantage in the sense that their required investment in this direction is likely to be lower. This implies that farmers in the south are disadvantaged in other dimensions relative to farmers in the rest of the country. Note, however, that the coefficient of the southern location becomes insignificant in the limited sample (table 3).

The quality of milk has a positive effect on the decision to adopt the reform, reflected in a positive effect of fat contents and a negative effect of SCC (table 3). The effect of protein contents is negative, which is counterintuitive, but is not significantly different from zero. A number of differences exist between the results of the full sample (table 2) and the limited sample (table 3). First, the positive effect of a potential rather than a definite successor becomes statistically insignificant in the limited sample. Second, as mentioned above, the effect of production also becomes insignificant in the limited sample. This could be either because production captures the effect of milk quality in the full sample, or because reporting milk quality is correlated with production, resulting in selectivity bias. Third, the negative effect of a cooperative society (as opposed to a producers' cooperation) becomes statistically significant in the limited sample. We cannot think of a theoretical justification for this effect other than selectivity bias.

Next, we want to examine whether the implementation of the reform reveals any information on top of the decision to adopt. Figure 2 shows that among the 65% of milk producers that decided to adopt the reform, 8% have not taken any action towards this goal, 24% started investing in one of the two required channels (production capacity and environmental protection), and 33% started investing in both channels. The model we chose for this analysis is the Ordered Probit maximum likelihood model. This is similar in principle to the Binary Probit model, the difference being that the range of the latent continuous variable is divided into a number of sub-ranges that is equal to the number of categories (four in our case). The model provides estimates of the three thresholds that define the four ranges, in addition to the coefficient estimates.

The Ordered Probit results are in tables 4 and 5, for the full sample and the limited sample, respectively. The results are qualitatively very similar to the Binary Probit results, indicating that implementation of the reform does not reveal much additional information on top of the information on the decision to adopt the reform. One difference that is worth mentioning is that the coefficient of years since last investment, which was only marginally significant in the Binary Probit model, is more significant in the Ordered Probit model. Note that the threshold estimates in the limited sample estimation (table 5) are not statistically different from zero. This means, in principle, that we are not able to distinguish between the sub-ranges of the latent adoption variable using the limited sample. We re-estimated the model using the limited sample and excluding the milk quality variables, and obtained significant thresholds. This indicates that it is not the loss of observations but rather the inclusion of the quality variables that causes the insignificant thresholds. Overall, the Ordered Probit results do not reveal any new insight that justified a more thorough examination of the differences between the full sample and the limited sample in this case.

Conclusions

We conclude that farm households responded to the initiation of the dairy policy reform in a way that is consistent with existing theories of technology adoption. In particular, they respond to economic incentives and weigh the long-run implications of their decisions. The results imply that the reform is particularly attractive for already strong producers. Strong producers may need a lower investment in order to comply with institutional requirements of the reform, and it is also easier for them to decide on a substantial investment with uncertain returns. Weaker producers, then, stay behind and will likely fade away by default in the long run.

This implies that despite the fact that the reform was planned to be in effect for a limited number of years, the desired structural change in the family-farm milk production sector will take much longer, essentially as long as the current generation of producers is around. This implies that the authorities should enable producers at least to sell their production quotas even after the expiration of the reform. Perhaps the incentives to give up the quotas should be improved, at least for the smallest producers, in order to speed the process.

Another implication that comes out of this research is that intergenerational succession is an extremely important element of decision making in farm households, and the response of these households to changes in the economic environment cannot be disentangled from the occupational decisions of their offspring. Elderly farmers without a successor value the farm as a life style more than a source of income, and being too old for starting a new career, will likely keep producing even under much less favorable conditions.

This research can be extended in several ways. More recent data on the implementation of the reform can be collected. This will also allow the analysis of a diffusion process which differentiates between producers that adopt early and those that adopt late. In addition, it might be possible to obtain data on the actual investments made by milk producers, which will provide a more precise picture on the steps that producers make during the gradual adoption process.

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Figure 1. Distribution of milk production

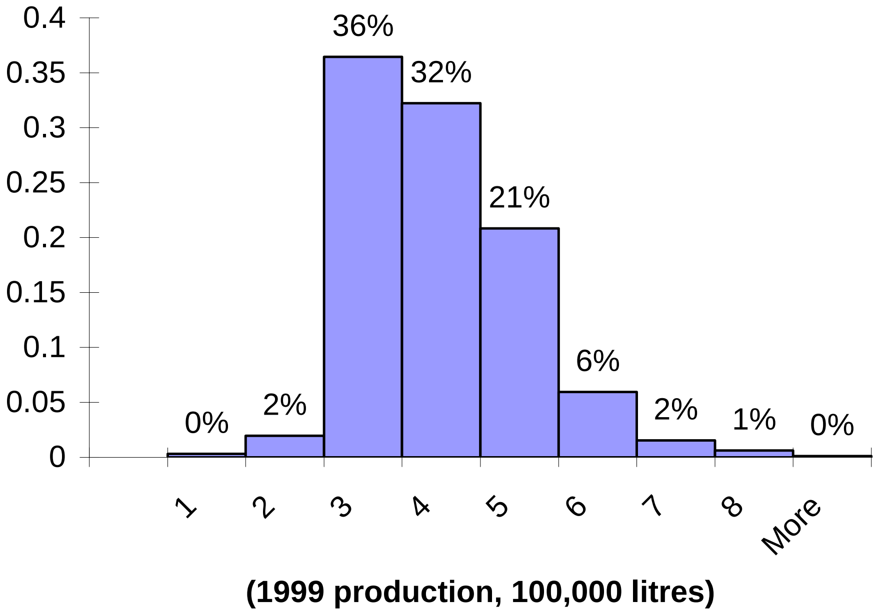

Figure 2. Distribution of adoption and implementation

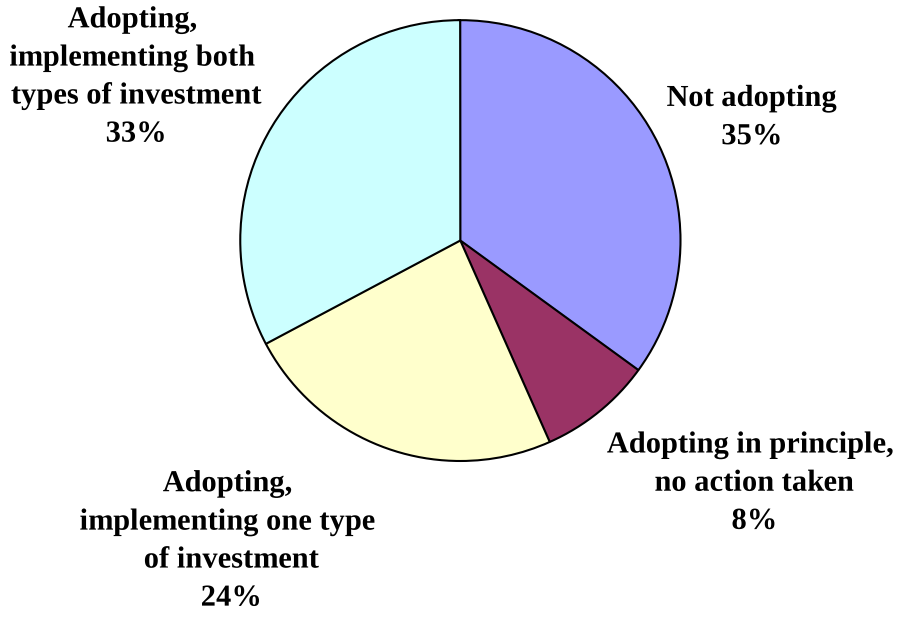

Table 1. Descriptive Statistics

Variable	Full sample Mean	Full sample Range	Limited sample Mean	Limited sample Range
Age	59.65	22-94	59.89	28-93
Household size	5.56	1-20	5.53	1-20
Professional training	0.26	0-1	0.29	0-1
Additional employment	0.44	0-1	0.46	0-1
Definite successor	0.47	0-1	0.47	0-1
Potential successor	0.33	0-1	0.34	0-1
Partnership	0.21	0-1	0.22	0-1
Production (10^5 liters)	3.08	0-8	3.14	0-7.6
Missing production	0.17	0-1	0.17	0-1
Self-producing	0.89	0-1	0.88	0-1
Protein (%)			3.11	2.49-3.48
Fat (%)			3.27	2.46-3.88
Somatic Cell Count (10^5/ml)			4.53	1.19-13.79
Years since last investment	5.35	2-30	5.25	2-28
Cooperative society	0.53	0-1	0.51	0-1
Producers' cooperation	0.20	0-1	0.21	0-1
Feed enterprise	0.41	0-1	0.48	0-1
Central sewer	0.79	0-1	0.79	0-1
Central region	0.41	0-1	0.40	0-1
Southern region	0.18	0-1	0.16	0-1
Adoption of reform	0.65	0-1	0.67	0-1

Table 2. Probit Results of Adoption of the Reform: Full Sample

Variable	Coefficient	Standard error	T-value	P-value	Marginal effect
Intercept	0.670	0.409	1.638	0.101	
Age	-0.019	0.004	-4.434	0.000	-0.70%
Household size	0.003	0.019	0.140	0.888	0.10%
Professional training	0.086	0.111	0.776	0.438	3.10%
Additional employment	-0.071	0.100	-0.712	0.477	-2.50%
Definite successor	0.855	0.133	6.409	0.000	31.00%
Potential successor	0.364	0.127	2.861	0.004	14.30%
Partnership	0.515	0.222	2.321	0.020	16.90%
Production	0.152	0.052	2.902	0.004	5.40%
Missing production	0.216	0.294	0.736	0.462	7.60%
Self-producing	-0.024	0.164	-0.145	0.885	-0.90%
Years since last investment	-0.020	0.011	-1.798	0.072	-0.70%
Cooperative society	-0.055	0.105	-0.525	0.600	-2.00%
Producers' cooperation	0.382	0.130	2.938	0.003	12.80%
Feed enterprise	-0.027	0.109	-0.246	0.806	-0.90%
Central sewer	-0.047	0.127	-0.369	0.712	-1.70%
Central region	-0.128	0.119	-1.075	0.282	-4.60%
Southern region	-0.391	0.146	-2.683	0.007	-14.60%
Number of observations	891				
Pseudo-R^2 (Estrella 1998)	11.43%				
% correct predictions	68.8				
Likelihood ratio statistic	103.25				

Table 3. Probit Results of Adoption of the Reform: Limited sample

Variable	Coefficient	Standard error	T-value	P-value	Marginal effect
Intercept	1.685	2.409	0.700	0.484	
Age	-0.018	0.005	-3.328	0.001	-0.60%
Household size	0.032	0.024	1.308	0.191	1.10%
Professional training	0.011	0.130	0.084	0.933	0.50%
Additional employment	-0.051	0.122	-0.420	0.675	-1.80%
Definite successor	0.860	0.167	5.146	0.000	30.50%
Potential successor	0.253	0.157	1.614	0.107	10.00%
Partnership	0.650	0.289	2.253	0.024	20.50%
Production	0.069	0.065	0.564	0.290	2.50%
Missing production	-0.216	0.065	0.374	-0.578	-7.90%
Self-producing	-0.212	0.207	-1.022	0.307	-7.10%
Protein	-0.874	0.762	-1.147	0.251	-31.60%
Fat	0.741	0.344	2.154	0.031	26.60%
Somatic cells	-0.063	0.032	-1.994	0.046	-2.20%
Years since last investment	-0.027	0.014	-1.990	0.047	-1.00%
Cooperative society	-0.257	0.132	-1.954	0.051	-9.20%
Producers' cooperation	0.399	0.155	2.580	0.010	13.20%
Feed enterprise	-0.105	0.127	-0.824	0.410	-3.70%
Central sewer	-0.100	0.157	-0.639	0.523	-3.50%
Central region	0.087	0.148	0.587	0.557	3.20%
Southern region	-0.129	0.187	-0.690	0.491	-4.70%
Number of observations	616				
Pseudo-R2 (Estrella 1998)	11.37%				
% correct predictions	73.2%				
Likelihood ratio statistic	70.91				

Table 4. Ordered Probit Results of Adoption and/or Implementation of the Reform: Full Sample

Variable	Coefficient	Standard error	χ^2 Statistic	P-value
Intercept No. 1	-2.016	0.354	32.436	0.000
Intercept No. 2	-1.780	0.353	25.406	0.000
Intercept No. 3	-1.091	0.351	9.654	0.002
Age	-0.015	0.004	15.765	0.000
Household size	0.003	0.016	0.026	0.873
Professional training	0.028	0.094	0.091	0.763
Additional employment	-0.005	0.084	0.004	0.949
Definite successor	0.771	0.116	44.143	0.000
Potential successor	0.324	0.112	8.284	0.004
Partnership	0.768	0.193	15.791	0.000
Production	0.176	0.044	15.919	0.000
Missing production	0.299	0.253	1.395	0.238
Self-producing	-0.072	0.141	0.265	0.607
Years since last investment	-0.022	0.009	5.596	0.018
Cooperative society	-0.028	0.090	0.095	0.758
Producers' cooperation	0.244	0.108	5.132	0.023
Feed enterprise	0.052	0.093	0.318	0.573
Central sewer	0.008	0.109	0.005	0.942
Central region	-0.164	0.101	2.637	0.104
Southern region	-0.556	0.127	19.078	0.000
Number of observations	891			
Pseudo-R^2 (Estrella 1998)	15.6%			
% correct predictions	48.1			
χ^2 statistic of model fit	146.01			

Table 5. Ordered Probit Results with Milk Quality Variables: Limited Sample

Variable	Coefficient	Standard error	χ^2 Statistic	P-value
Intercept No. 1	-2.492	2.042	1.490	0.222
Intercept No. 2	-2.277	2.041	1.244	0.265
Intercept No. 3	-1.566	2.041	0.589	0.443
Age	-0.016	0.005	11.581	0.001
Household size	0.027	0.200	1.724	0.189
Professional training	0.006	0.110	0.003	0.955
Additional employment	-0.041	0.102	0.159	0.690
Definite successor	0.823	0.143	32.917	0.000
Potential successor	0.205	0.136	2.280	0.131
Partnership	0.776	0.234	10.961	0.001
Production	0.129	0.054	5.652	0.017
Missing production	0.113	0.308	0.135	0.713
Self-producing	-0.175	0.172	1.034	0.309
Protein	-0.779	0.660	1.390	0.238
Fat	0.708	0.295	5.755	0.016
Somatic cells	-0.063	0.027	5.385	0.020
Years since last investment	-0.031	0.012	7.141	0.008
Cooperative society	-0.158	0.111	2.013	0.156
Producers' cooperation	0.250	0.127	3.844	0.050
Feed enterprise	0.019	0.108	0.030	0.863
Central sewer	0.012	0.131	0.009	0.926
Central region	-0.035	0.125	0.077	0.782
Southern region	-0.359	0.161	4.995	0.025
Number of observations	616			
Pseudo-R^2 (Estrella 1998)	16.50%			
% correct predictions	48.8			
χ^2 statistic of model fit	107.15			